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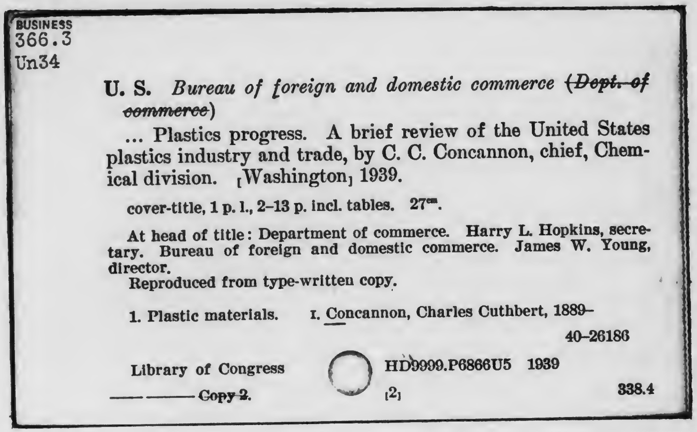

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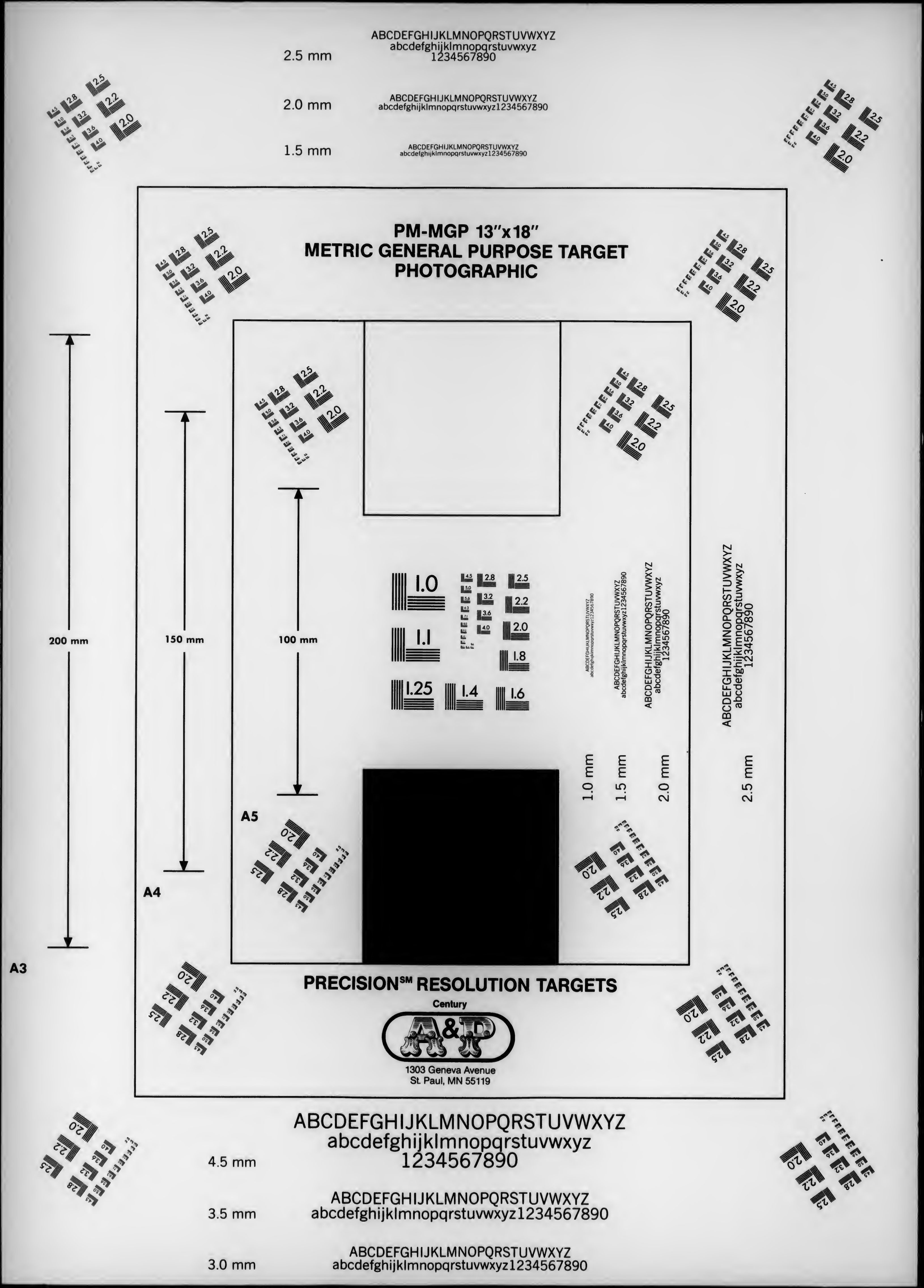

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James W. Young, Director

PLASTICS PROGRESS

A BRIEF REVIEW
OF THE UNITED STATES
PLASTICS INDUSTRY AND TRADE

by
C. C. CONCANNON
CHIEF, CHEMICAL DIVISION

NOVEMBER 1939

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F O R E W O R D

Organic plastics are employed in many fields. The chemical industry itself uses its own plastics in its own establishments and supplies large quantities to allied industries. Pyroxylin plastics and the phenolic resins have been followed by numerous other types and varieties, until today chemistry is able to supply the consuming industries with products for practically any and every purpose. The acrylates, for example, constitute a group, which while historically old are the youngest industrially and are sometimes called "synthetic organic glass".

This study of plastics is necessarily in outline in view of the fact that this branch of chemical industry has advanced so rapidly that the plastics picture is indeed kaleidoscopic. To treat the subject adequately would require volumes. The present study which was prepared in the Chemical Division, is therefore devoted chiefly to a description of the principal groups and to a statistical study of production and foreign trade.

Further information may be obtained from the Bureau upon request directly or through the Bureau's district and cooperative offices.

James W. Young, Director,
Bureau of Foreign and Domestic Commerce.

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PLASTICS

Introduction

Plastics, generally speaking, are substances capable of being molded or otherwise fabricated into a desired solid form, together with coloring matter or a filler, this condition being obtained by the physical and/or chemical interaction of a wide range of materials. The past quarter of a century, and more particularly the last decade, has witnessed a phenomenal growth in the manufacture of organic plastics in the United States, until today the many and varied uses of such products assures a permanent and important place in our national economy for this very progressive branch of chemical industry. In fact, it is due to the wide and increasing demand for information pertinent to this branch of plastics, which actuates this presentation.

Products of the Industry

The plastics industry, although strictly a chemical processing industry, has developed to such an extent in certain specific lines that some of the finished products are no longer considered, from a marketing standpoint, as chemical products. For example, rayon (artificial silk) is considered in connection with textiles: "Cellophane", a transparent wrapping material, is marketed by paper merchants. Similarly rubber substitutes, cementation plastics, smokeless powder, pyroxylin lacquers, imitation leather, and photographic films, are products of the plastics industry, as a whole, but are arbitrarily excluded from this review. Plastics have become a practical substitute for such articles as steel, copper, rubber, wood, glass, etc., and are therefore familiar objects in our daily contact with industry, home, communication, and all manner of personal possessions.

Among the various trade names under which plastics appear are: Celluloid, Bakelite, Pyralin, Vinylite, Durez, Catalin, Textolite, Plaskon, Tenite, Fiberloid, Phenolin, Beetle, Resinox, Formica, Marblette, these being only a partial list of the many plastics which have advanced tremendously, and no doubt will continue to have future usefulness in remaking the industry.

Plastics are used in practically every industry and while appearing on the market in thousands of forms may be grouped in general under the following technically descriptive heads:

Semi-finished	Finished
Sheets	Molded (a) hot, (b) cold
Rods	Extruded
Tubes	Machined
Granules	Laminated
Powder	Cast (polymerized)
Liquid (mono- or partial polymer)	

The increasing application of plastics in industry and their utilization in every day life explains their advance to a position of importance, not only in our domestic industry, but in world commerce. By way of illustrating the wide variety of uses of these products, and for the purpose of this review we may consider them in three groups - cellulose plastics, synthetic resins, and those of protein origin.

Different types of plastics have varied properties. The materials in general have smooth surfaces which are not subject to rust, chipping, or denting, and are resistant to solvents, grease, etc. They are light, and durable as well as tough.

(A) CELLULOSE PLASTICS

United States Production

In the cellulose group, nitro- or aceto-cellulose, familiar trade-mark names will be found such as "Celluloid", "Pyralin", "Viscollid", "Fiberloid", "Xylonite", "Lumarith", "Tenite", etc.

They are made by incorporating a plasticiser such as, for example, camphor with the cellulose derivative dissolved in a suitable solvent together with a stabilizer, usually urea or one of its derivatives. Other chemical compounds, such as the salts of lactic, butyric, benzoic, and camphoric acids, have been suggested for this purpose. Plasticisers other than camphor, such as borneol, acetanilid, naphthalene, and phenylnaphthalene, have proved useful, and esters, such as triphenyl phosphate, tricresyl phosphate, and trinaphthyl phosphate are also employed as camphor substitutes.

Cellulose acetate is a derivative of cellulose and is similar in its working characteristics to pyroxylin, but differs chiefly from pyroxylin in that it is more stable to light and heat and less flammable.

Increase in the use of cellulose acetate sheeting, as the plastic filler sandwiched between two glass plates to form safety glass, has been spectacular. Since 1932, before which its use for this purpose was negligible, acetate all but entirely displaced pyroxylin for this purpose and is now in turn being superseded in large measure by the vinyl resins.

The statement below released by the Bureau of the Census gives statistics on the United States production of cellulose plastics in 1937 with comparative figures for 1933 and 1935.

	1933	1935	1937	Number of Establis ments,by States,193
Nitrocellulose (pyroxylin				
Number of establishments	12	13	11	Conn.1; Mass., 4; N.J.,4; N.Y.2.
Total production not including finished articles, pounds	12,945,556	16,299,519	18,122,788	
Made and consumed in same establishments, pounds	2,849,523	2,958,859	3,271,971	
Produced for sale -				
Pounds	10,096,033	13,340,660	14,850,817	
Value	$7,799,283	$10,682,358	$12,526,206	
Finished articles of nitrocellulose (pyroxylin) made in producing establishments in Chemicals Not Elsewhere Classified industry, value	$5,029,356	$5,116,420	$5,390,313	
Cellulose acetate:				
Number of establishments	5	6	6	Mass.,1; N.J.,3; N. Y.,1; Tenn.,1.
Pounds	2,874,819	10,395,290	18,923,663	
Value	$2,245,543	$ 7,986,489	$12,199,744	

Imports

All compounds of cellulose (except cellulose acetate, but including pyroxylin and other cellulose esters and ethers) and all compounds, combinations or mixtures.

	1937		1938	
	Pounds	Value	Pounds	Value
Transparent sheets				
3/1000 to 32/1000 in. thick	5,313	$1,928	3,588	$1,812
Sheets, n.e.s.	36,952	27,041	22,887	29,034
Tubes*	*		12	26
Other forms	31,361	37,920	22,633	18,639
Sheets, bands, strips of transparent			26,099	10,420

* Rods, 259 pounds, $90 in 1937.

	Quantity		Quantity	
Dolls of cellulose compounds (celluloid, etc.)				
Having movable parts, number	6,485,943	123,927	2,263,235	44,017
Not having movable parts "	270,039	4,318	105,060	2,017

Imports (Cont'd)	1937		1938	
	Quantity	Value	Quantity	Value
Toys and parts, n.s.p.f.				
(cellulose compounds (Celluloid, etc.)				
Having movable parts, No.	10,219,383	269,085	4,194,917	104,090
Not having movable parts, number	3,376,432	63,628	912,493	18,825
Parts "	984	63	---	---
Handles or backs for toilet brushes of cellulose compounds (celluloid, etc.)				
For tooth brushes, number	7,752,044	73,485	5,467,768	49,609
For other toilet brushes, number	6,768	344	26,604	1,134
Buttons				
Buttons of cellulose compounds (celluloid, etc.) gross	151	306	1,166	506
Cellulose acetate and compounds combinations, or mixtures, containing cellulose acetate, made into finished or partly finished articles, n.s.p.f.				
Toilet articles (incouding pin trays, powder boxes, etc.)		3,950		1,014
Other articles		17,166		9,842
Compounds of cellulose (except cellulose acetate) and all compounds, combinations, and mixtures of which any such compound is the component material of chief value, made into finished or partly finished articles, n.s.p.f.	5,951	3,814	2,786	1,675
Slides used as buckles, gross				
Toilet articles, n.s.p.f. (include pin trays and powder boxes, etc.)		46,515		29,510
Other articles, n.e.s.		432,464		293,371
Manufactures of bands, sheets, and strips of transparent cellulose film (including bags, sachets, etc.)		6,772		3,482
Combs, except wholly of metal or rubber, n.s.p.f.				
Cellulose compounds, (celluloid, etc.) - valued $4.50 or less per gross, number	10,078,206	172,751	2,336,464	56,512
Cellulose compounds, (celluloid, etc.) - valued over $4.50 per gross, Number	233,913	13,266	212,976	14,988
Mechanical pencils or cellulose compounds (celluloid, etc.) gross	3,711	6,167	827	1,296

Exports

	1937		1938	
	Pounds	Value	Pounds	Value
Pyroxylin scrap and film scrap	3,473,281	$290,053	1,037,666	$119,094
" plastic film support	3,689,468	3,264,565	3,417,709	2,855,087
" sheets, rods or tubes	613,004	457,929	341,826	276,595
" manufactures		440,712		517,583
	Quantity		Quantity	
Buttons, button parts, etc.				
Of cellulose compounds, galalith and other plastics, gross	414,814	210,023	308,855	173,716
Mechanical pencils of cellulose compounds, dozens	116,907	269,069	69,709	233,246
Fountain pens of cellulose compounds, dozens	135,922	1,398,712	142,150	1,288,391

(B) SYNTHETIC RESINS

The development of uses and markets for synthetic resin products has been largely the result of American inventive genius and merchandising skill. The utilization of the pioneer type - the phenol-formaldehyde resins - was followed by the development of the coumarone and indene resins, the tar acid, alkyd and resorcinol resins, and others representing the coal-tar group, and subsequently the noncoal-tar organics, the urea, thio, vinyl, furfural, and other resins.

Approximately 90 percent of all synthetic resins produced in the United States are of coal-tar origin the remainder being made of urea and other materials.

United States Production

The importance of the synthetic resin plastics is becoming more and more apparent through their use in such commonplace articles as bottle caps, radio parts, timing gears, and furniture, as well as their employment in the automobile, electrical, and marine industries, and in the manufacture of printing inks, varnishes and lacquers. The synthetic resin group includes familiar trade mark names such as "Bakelite", "Catalin", "Durez" "Formica", "Micarta", etc.

Production of synthetic coal-tar resins aggregated 106,923,244 pounds in 1938 a decline of 25 percent in production, and 23 percent less in value of sales ($15,810,538) than in 1937 when production was 142,024,541 pounds and sales value $20,582,156. Non-coal-tar resins increased 11 percent in production to 23,435,408 pounds and 24 percent in value of sales to $7,061,436 in 1938 compared with production of 21,005,869 pounds and sales of $5,680,600 in 1937, partly as a result of commercial production of the relatively high-priced vinyl acetals for use in safety glass manufacture. Resins derived from urea are shown separately for the first time in 1938. Resins derived from tar acids (phenol, cresols, and xylenols) decreased in output in 1938 to 43,964,838 pounds compared with 80,880,522 pounds in 1937 while alkyd resin production in 1938 also decreased totaling 40,996,727 pounds compared with 61,254,019 pounds in 1937.

In 1937, synthetic resins of coal-tar origin reached a domestic production peak figure of 142,024,541 pounds. Production and sales data during recent years are shown in the following table:

Synthetic Resins of Coal-Tar Origin

Year	Production	Sales	
	Pounds	Pounds	Value
~~1933~~	41,628,485	31,657,653	$7,238,560
1934	56,059,489	43,350,876	10,126,849
~~1935~~	90,913,162	65,923,334	12,777,195
~~1936~~	117,301,780	86,213,735	17,056,099
~~1937~~	142,024,541	109,201,349	20,582,156
~~1938~~	106,923,244	84,763,503	15,810,538
Derived in 1938 from:			
Alkyd resins:			
Maleic anhydride	3,432,887	2,978,718	634,935
Phthalic anhydride	37,563,840	21,931,783	4,467,466
Tar Acids:			
Cresols or cresylic acid	5,284,895	3,882,988	561,432
Phenol:			
For molding	13,487,681	12,787,051	2,189,600
For casting	4,807,671	4,651,991	1,896,425
Other	17,658,391	17,484,415	2,939,971
Xylenols	329,927		
Xylenols and cresols	2,396,273		

Synthetic Resins of Non-Coal-Tar Origin

Year	Production	Sales	
	Pounds	Pounds	Value
~~1933~~	3,571,717	3,256,411	$1,745,102
1934		3,500,839	1,491,145
From urea or thiourea	3,470,916	3,115,608	1,290,802
1935			
from: acrylic acid)	17,686	12,054	7,602
adipic acid)			
terpenes)			
urea	4,202,536	4,005,083	1,828,565
1936	15,611,041	14,766,640	3,591,467
1937	21,005,869	18,891,277	5,680,600
~~1938*~~	23,435,408	17,064,685	7,061,436

* Preliminary.

Finished Products (Synthetic Resins, Etc.)

By Kind and Value: 1935 and 1937

	1935	1937
1. "Synthetic-Resin, Cellulose-Plastic, Vulcanized-Fiber, and Molded and Pressed Pulp Fabricated Articles, not Elsewhere Classified" industry, all products, total value	$50,298,937	$77,715,723
2. Fabricated articles of synthetic resin, nitrocellulose, cellulose acetate, transparent cellulose sheeting, vulcanized fiber, and wood pulp	46,966,309	73,037,371
3. Other products (not normally belonging to the industry)	1/3,332,628	4,678,352
4. Fabricated articles of synthetic resins, etc., made as secondary products in other industries	7,996,148	(2)
Fabricated articles of synthetic resins, etc., total value (sum of 2 and 4)	54,962,457	3/73,037,371
Synthetic-resins (phenolic, urea, vinyl, acrylate, etc.):		
Laminated products:		
Sheets, plates, blocks, rods, tubes, and blanks	4,767,616	12,588,713
Gears, bearings, and other machine parts	5,912,006	(2,765,009
Electrical goods		(1,237,868
Other and not specified		(4,251,736
Molded or cast:		
Electrical goods	23,304,135	(6,692,804
Closures		(2,962,312
Battery boxes		(2,625,632
Housings (for cameras, scales, radios, etc.)		(1,235,769
Cigarette cases, compacts, vanity cases, and similar articles		(764,075
Other and not specified		(14,531,304
Cellulose compounds (nitrocellulose, cellulose acetate, etc.) - Housings (for radios, etc.), cigarette cases, compacts, vanity cases, and similar articles, and those not specified	8,534,474	5,867,839
Vulcanized fiber:		
Rods, tubes, and other unfinished forms	4,718,844	2,948,657
Hollow ware (boxes, cans, pails, etc.)	1,044,749	1,975,623
Laminated sheets and plates	2,389,313	(4,767,728
Other and not specified		(1,918,776
Molded pulp products (dishes, egg-case liners, etc.	4,291,330	(4,196,621
Fiber conduits and fittings		(1,710,905

1/ Includes a small amount received for custom work
2/ Not yet available; will be shown in final report
3/ Incomplete; see footnote 2.

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Imports

Incoming shipments of synthetic resins is relatively small, United States production supplying the great national market with an exportable surplus. Imports in recent years have been as follows:

Imports		1937		1938	
		Quantity	Value	Quantity	Value
Synthetic phenolic resins,	pounds	18,977	$14,278	$17,762	$7,381
Synthetic gums or resins of non-coal-tarorigin,	pounds	3,175	843	112,017	92,394
Beads, of synthetic resin			198		----
Products of which any synthetic resin or resin-like substance is the chief binding agent					
Sheets or plates,	pounds	----	----	3,361	3,843
Laminated rods, tubes, blocks strips, or blanks	pounds	668	1,920	307	1,457
Manufactures of any of the foregoing, n.e.s.	pounds	10,397	39,232	4,923	32,180
Handles and sticks for umbrellas, sunshades, and walking canes					
Of synthetic resin	dozens	8	76	2	34
Manufactured products, not laminated, of which any synthetic resin or resin-like substance is the chief binding agent, n.s.p.f.	pounds	8,759	18,001	7,099	10,097

Exports

An increased domestic production now permits the exportation of synthetic resins:

		1937		1938	
		Quantity	Value	Quantity	Value
Synthetic gums and resins,	pounds	6,906,431	$1,374,552	6,919,627	$1,328,171
Synthetic resin products;					
Laminated and cast sheets, plates, tubes, rods, blocks, and other unfinished forms.	pounds	405,548	225,903	425,372	326,169
Molded products,	"	184,172	123,827	271,287	160,114
Other synthetic resin products,	"	123,474	81,993	152,988	107,425
Synthetic resin, etc. jewelry					
Men's			30,188		32,434
Women's			167,405		121,748

(c) HARDENED CASEIN

An interesting class of plastic materials is manufactured from casein, a protein substance found in milk. Upon treatment of casein with formaldehyde, a tough material, white and hornlike in appearance, is formed. This material is noninflammable and capable of taking a high polish. Dyes may be incorporated with it or pigments or fillers used to produce a mottled or striated effect and the resulting appearance rivals that of ivory, coral, tortoise shell, and similar natural products. It is at present used for buttons, beads, fountain pens, and in the manufacture of numerous other fancy goods.

The production of this material consititutes a well-established industry in Europe, where the product is sold under the name of "galalith". Production in the United States, however, is limited, and the domestic casein industry is still in its infancy. Official statistics are not available but several years ago the domestic output was estimated at about 2,500,000 pounds annually.

Imports in 1938 of casein compounds, galalith, etc. in blocks, sheets, rods, tubes and other forms, not in finished or partly finished articles, 80 percent of which came from the United Kingdom, totaled 5,435 pounds, valued at $3,451. Imports of finished articles were as follows:

		1937		1938	
		Quantity	Value	Quantity	Value
Galalith buttons,	gross	554,324	233,721	300,701	121,747
Composition horn buttons	"	55,390	54,527	17,233	16,120
Casein compounds, galalith, etc., in finished and partly finished articles,	pounds	15,423	32,256	33,133	32,969

(D) PLASTICS DIRECTORIES

The Bureau of Foreign and Domestic Commerce does not collect and compile names of American firms for distribution. There are several reasons for this policy: the field is covered very completely by unofficial directories; if a Government agency underto k to furnish such a service it would be necessary to supply complete lists under specified headings, otherwise it would be subject to criticism from any firms not included in a particular list; the cost of such a service (which would be considerable) could not be justified since it would be a duplication of private activities.

Modern Plastics, 122 East 42nd St., New York, N. Y. issues a catalog, directory and buyer's guide each year. The last one was issued in October, 1939.

Chemical and Metallurgical Engineering, 330 West 42nd St., New York, N. Y.

"Directory of Plastics", published originally in August 1931, supplemented in 1932 and 1933 and revised in the November 1934 issue.

The Plastic Industry in America, published by Thomas Publishing Company, 469 Eighth Ave., New York, N. Y. This publication contains classified lists of companies engaged in the plastic industry. There is included a description of the materials used as plastics, as well as informative announcements from manufacturers engaged in the plastic industry.

Chemical Buyer's Guide Book, published annually by "Chemical Industries", 522 Fifth Ave., New York, N. Y.

Green Book Buyers' Directory, published annually by Oil, Paint and Drug Reporter, 59 John St.,New York, N. Y.

~~The Plastics Industry, a brief survey issued by Investment Management Department of Mackubin, Legg & Co., Baltimore, Md. describes the industry and gives names of firms manufacturing various plastic materials.~~

Organic Plastics.- A circular of the National Bureau of Standards, C411, describes various types of plastics and lists manufacturers' bulletins giving name of company and products. For sale by the Superintendent of Documents, Washington, D. C., price 5 cents.

Dyes and Other Synthetic Organic Chemicals in the United States, report of the U. S. Tariff Commission lists manufacturers of synthetic resins; for sale by the Superintendent of Documents, Washington, D. C. The last printed Report (132) was for the year 1937 and the price affixed is 10 cents.

Synthetic Resins and Their Raw Materials, Report No. 131, Second Series, of United States Tariff Commission. A survey of the types and uses of synthetic resins, the organization of the industry, and the trade in resins and raw materials with particular reference to factors essential to tariff consideration. The appendix contains a glossary, lists of trade names and of manufacturers of synthetic resins in the United States, United Kingdom, and Germany, and of the producers of resin raw materials in the United States. The report may be purchased from the Superintendent of Documents, Washington, D. C. at 25 cents per copy.

The foregoing lists, are, of course, incomplete and the omission of any trade journal or directory implies no reflection, nor should the mention of any be construed as a recommendation or a preference by the Commerce Department's Chemical Division. Many of the directories and other publications referred to herewith may be consulted at public libraries, chambers of commerce, and in some instances at the district offices of the Bureau of Foreign and Domestic Commerce.

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Prices

Current market price in:

Oil, Paint and Drug Reporter, 59 John St., New York City.
Chemical Industries, 522 Fifth Avenue, New York, N. Y.

Tariff

Information concerning rates of duty on imports into the United States can be obtained from the Customs Service, Treasury Department, Washington, D. C.

Trade Associations

Synthetic Organic Chemical Manufacturers Association,
280 West Broadway, New York, N. Y.

Cellulose Plastics Manufacturers Association,
631 Tower Building, Washington, D. C.

Synthetic Resin Manufacturers' Association, Inc.,
17 Battery Place, New York, N. Y.

Society of the Plastics Industry, Inc.,
10 East 40th St., New York, N. Y.

Casein Plastics Manufacturers and Fabricators Asso., Inc.,
50 East 41st Street, New York, N. Y.

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